United States Department of the Interior

TAKE PRIDE IN AMERICA

BUREAU OF LAND MANAGEMENT
Salt Lake District Office
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Salt Lake City, Utah 84119

IN REPLY REFER TO:

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(UT-022)

977-4300

FEB 25 1994

Dr. Dianne Nielson
Director, Utah Department of Environmental Quality
168 North 1950 West
P.O.Box 144810
Salt Lake City, Utah 84114-4810

RECEIVED
FEB 28 1994
UTAH DEPT. ENVIRONMENTAL QUALITY
EXECUTIVE DIRECTOR'S OFFICE

Dear Dianne,

The next meeting of the Technical Review Committee will be held on March 2, 1994 at the U.S.G.S. office at 1745 West 1700 South, Salt Lake City, Utah (just west of Redwood Road on 1700 South). The meeting will begin at 9:00 am. There will be no pre-meeting at this time. Paul Anderson has requested that you be prepared to consider officers for 1994 at this meeting,

I have enclosed the quarterly report of the U.S.G.S. for your review. I look forward to seeing you at the meeting.

Sincerely,

Deane

Deane H. Zeller
District Manager

[illegible]

Enclosure:
As Stated Above

Wally Gwin UGS.

[illegible]

Called
3-1
[illegible]

PROGRESS AND PLANS FOR THE BONNEVILLE SALT FLATS STUDY, NOVEMBER, 1993, THROUGH FEBRUARY, 1994

March 2, 1994

Progress:

A location and elevation data set was received from the BLM Cadestral Suvey on February 2, 1994. With this data set, interpretation of the hydrologic data can now progress. Our data report, which will include well identifications, water-level, specific-gravity, and temperature measurements, and chemical analyses, is progressing. A draft of this report, which is not interpretative, should be available by late spring.

Water-level measurements in wells on the Bonneville Salt Flats for the months of March and September, 1992, and April and August, 1993, have been entered into our spreadsheet program for density correction. A preliminary potentiometric-surface map for the August, 1993, data set is being prepared and will be presented at the meeting. This map will be used to make water and salt budget calculations that are representative of production (summer) conditions. Corresponding water-level measurements in wells from Pilot Valley will be processed in a similar manner.

Water-level measurements and elevation data were used to calculate depth-to-water values below land surface. These values were compared to the statistics describing the various classified groups on the August, 1993, Thematic Mapper satellite image (mentioned in previous progress report). The depth-to-water values from wells in each classified area were compared initially to the statistics representative of that classified area. This resulted in a less than significant correlation. A better correlation might be possible by comparing a depth-to-water value directly to the statistics representing the pixel at the well location. More explanation will be given at the meeting.

Through discussions with Jim Kohler (BLM), we agreed there is some evidence to suggest that the potassium concentration might have decreased from 1976 to 1992in the shallow-brine aquifer toward the north end of the salt crust. When a complete set of chemical anaylses is available, the seasonal values for potassium in Pilot Valley and the Bonneville Salt Flats will be examined for seasonal trends.

Tritium values determined from samples collected from observation wells completed in the alluvial-fan aquifer are not indicative of recent recharge by direct flow through fractures at land surface. This does not mean that direct recharge through these pipes is not occuring, but rather, it might indicate that ground-water flow velocites are extremely slow in this area.

Tritum values determined from samples collected along line of wells extending from salt crust to collection ditch (see figure) suggest that there is no stratification of brine between shallow wells (about 8 feet deep) and deeper wells (15 to 25 feet deep). The values increase from the salt crust toward the collection ditch thus indicating the lack of infiltration from winter surface ponds the closer the proximity to collection ditch. A similar but not as obvious trend can be seen directly to the south. The high tritium values adjacent to I-80 and at the west margin also suggest the lack of infiltration from winter surface ponds. The low tritium values along the axis of the salt crust suggest the possibility of upward leakage. This contradicts corrected head data that indicate downward leakage.

Plans for next quarter include continued hydrologic and chemical interpretation, increasing refinement of model simulations, and preparation of data and interpretative reports.

Model progress:

Superimposing the areal model mesh at 2000 ft. by 2000 ft. on a Geographical Information System map of the region resulted in a slight relocation of the production ditch locations. There will also be a relocation of the northwest boundary to bring it into allignment with the outermost wells and the estimated contact between the shallow brine aquifer and the alluvial fan aquifer.

A finer mesh was established for the three-dimensional model (Fig. 1). It was based on 1000 ft. by 1000 ft. node spacing in the horizontal directions and 5 ft. node spacing in the vertical. In addition, the mesh was refined to 500 ft. node spacing adjacent to the ditches. The resulting mesh gives about 33000 nodes of which about 27500 are in the active simulation. Simulations of the ground-water flow only for 180 days take about 2.5 hours on a Data General 530 workstation. This time will increase by a factor of 4 for the complete simulations of flow and transport.

Increasing the number of node layers means that the production ditch penetrates down three layers below the top of the model region. This means the leaky river boundary condition formerly used to represent the ditch had to be changed. A specified pressure boundary condition was used to represent the ditch and the ditch segments were alligned with rows of node points.

For the new version of the three-dimensional model, the northern boundary was changed to specified pressure, and the bottom boundary was changed to a leaky boundary. Now that water level elevations from the wells are available, we reviewed the boundary water levels and made a more detailed piecewise constant head distribution along the 5 lateral boundaries.

Major boundary condition changes include:

1. Setting the northern boundary to specified pressure corresponding to a head of 4214.1 and 4214 ft. over the two segments. It was formerly a specified flux boundary.

2. Setting the external head at the northwest leaky boundary to 4213.7 and 4214 ft. The low head of 4206 ft. observed by Lines was not seen in our recent data.

3. Setting the southern ditch boundary to 4200 ft. This is an estimate based on visual observations.

4. Setting the remaining ditch boundary to 4208 ft.

5. Using an average head from 5 wells that penetrate the basin fill aquifer converted to a brine density of 73.6 lb/ft^3. This model is still being run as a constant density model until the boundary condition values are established.

6. Using a permeability of the basin fill aquifer typical of an unweathered clay.

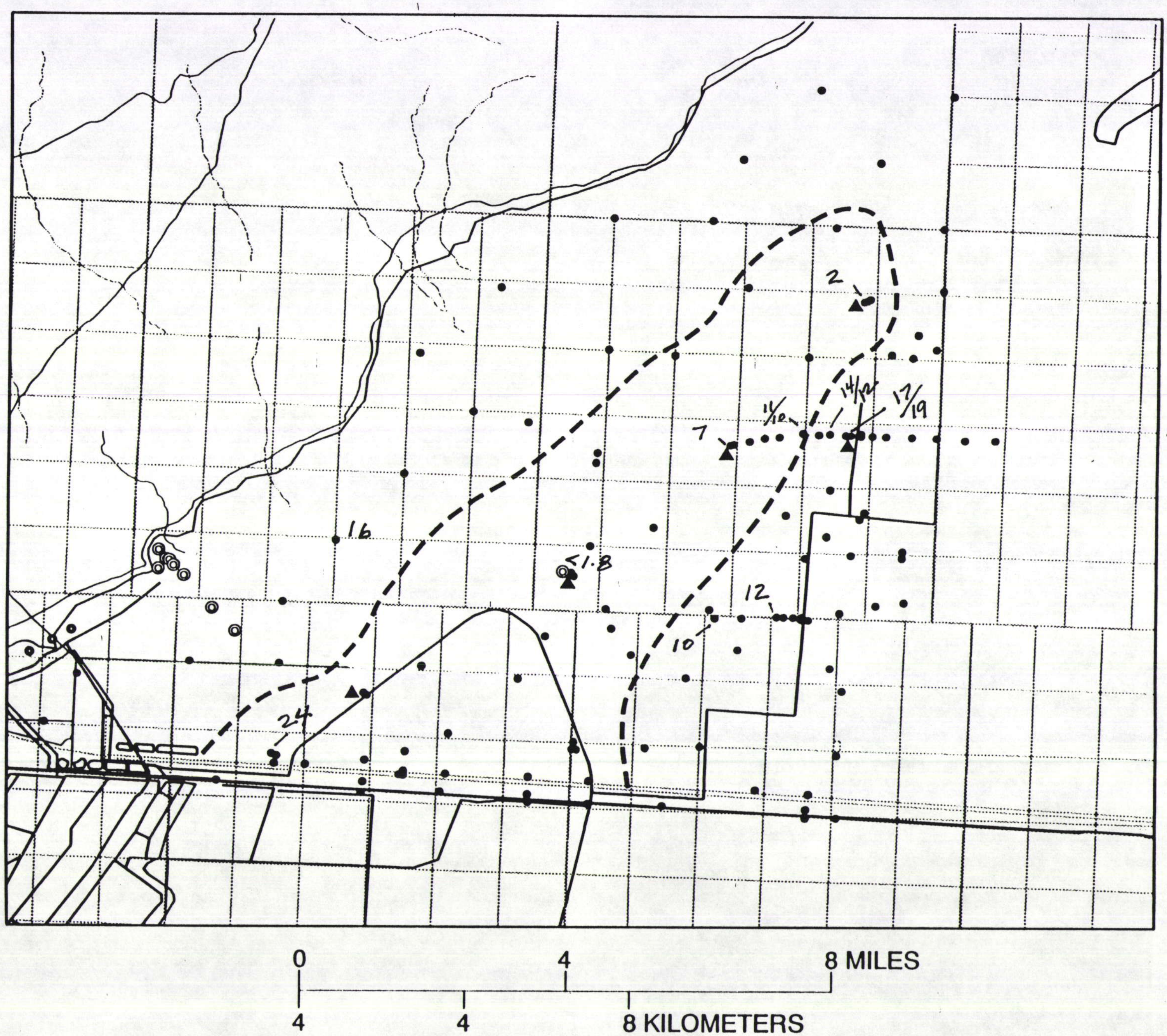
The model was run for 6 months of simulated time starting at an initial condition of static fluid with a horizontal water table at 4214 ft. The results depend on the initial condition assumed because a steady flow field is not achieved after 6 months. There is still more than 2 times the flow rate out from the system than into it.

Table 1 shows the flow rates for each boundary face at the end of the simulation. A computer program to sum the individual cell flow boundary flow rates was written to produce the values appearing in the table. The leakage across the bottom boundary is downward into the basin fill aquifer over most of the area but it is upward into the shallow brine aquifer in the vicinity of the southern boundary due to the low heads imposed there. A wire mesh view of the water table at the end of the simulation appears in Figures 2-4. The major influences are the head in the production ditch and in the ditch that forms much of the southern boundary.

A boundary condition that remains to be quantified is the net evaporation rate over the model area during the summer production period. The net infiltration from preciptiation during the winter non-production period also needs to be determined from measured data.

The problem of determining a suitable initial condition for the transient simulations remains. To answer the salt balance question, we need to formulate initial and boundary conditions for a "typical" production season and a "typical" non-production season, even though no particular year may be "typical". Initial conditions for the brine concentration also need to be formulated before brine transport simulations can be done.

A comparison of Lines' brine density vs. dissolved solids function to a density vs. salinity function from the literature was made. It showed a maximum difference in density of 1.7% at a mass fraction of 0.25. Lines' equation was a linear regression on field data while the literature equation was based on laboratory data on NaCl solutions. Either equation appears suitable for our simulation work.



11/10 - upper value for shallower of two wells

Hydrologic data sites - locations approximate

Tritium values (in Tritium Units) for August 1993

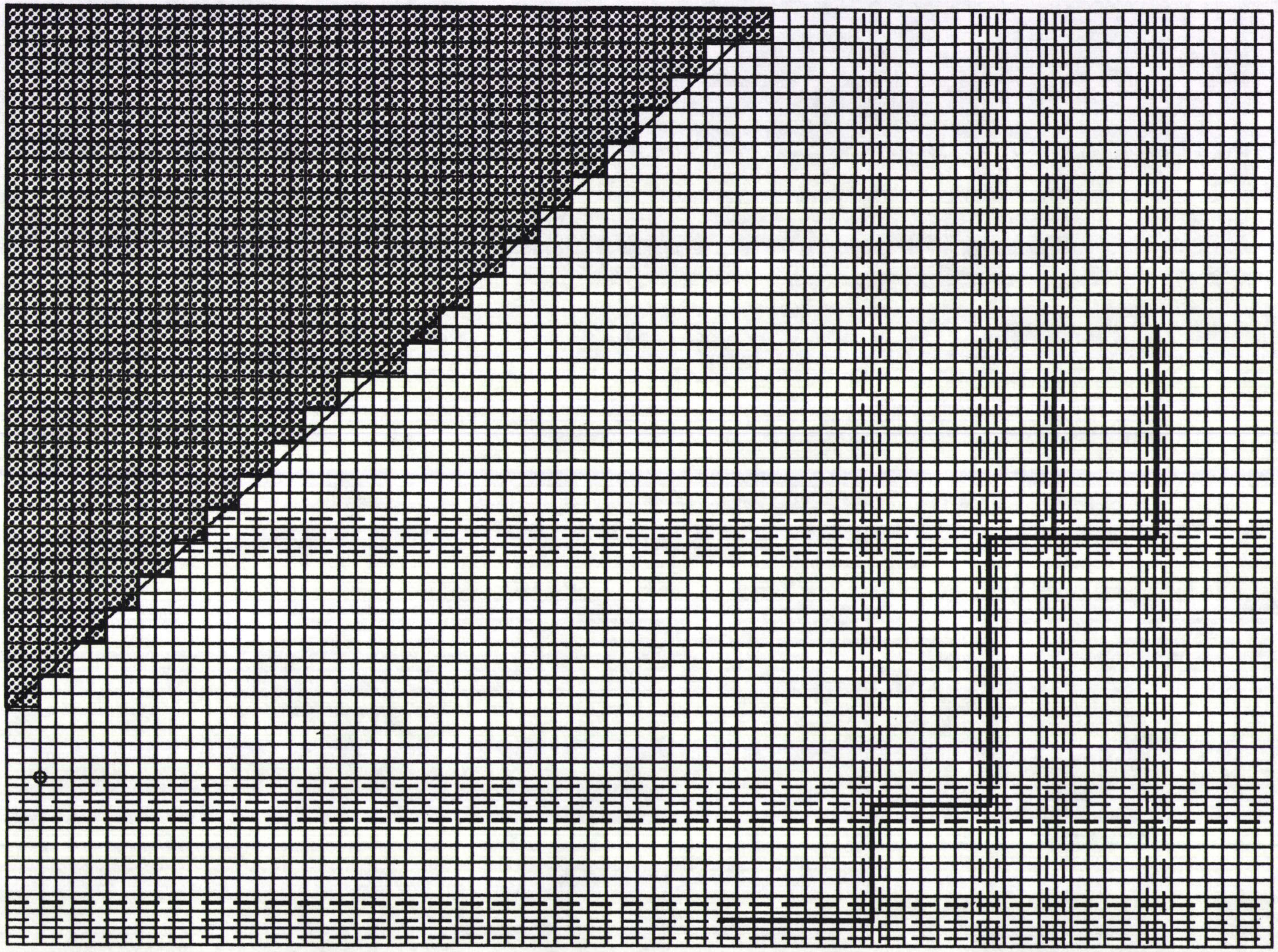
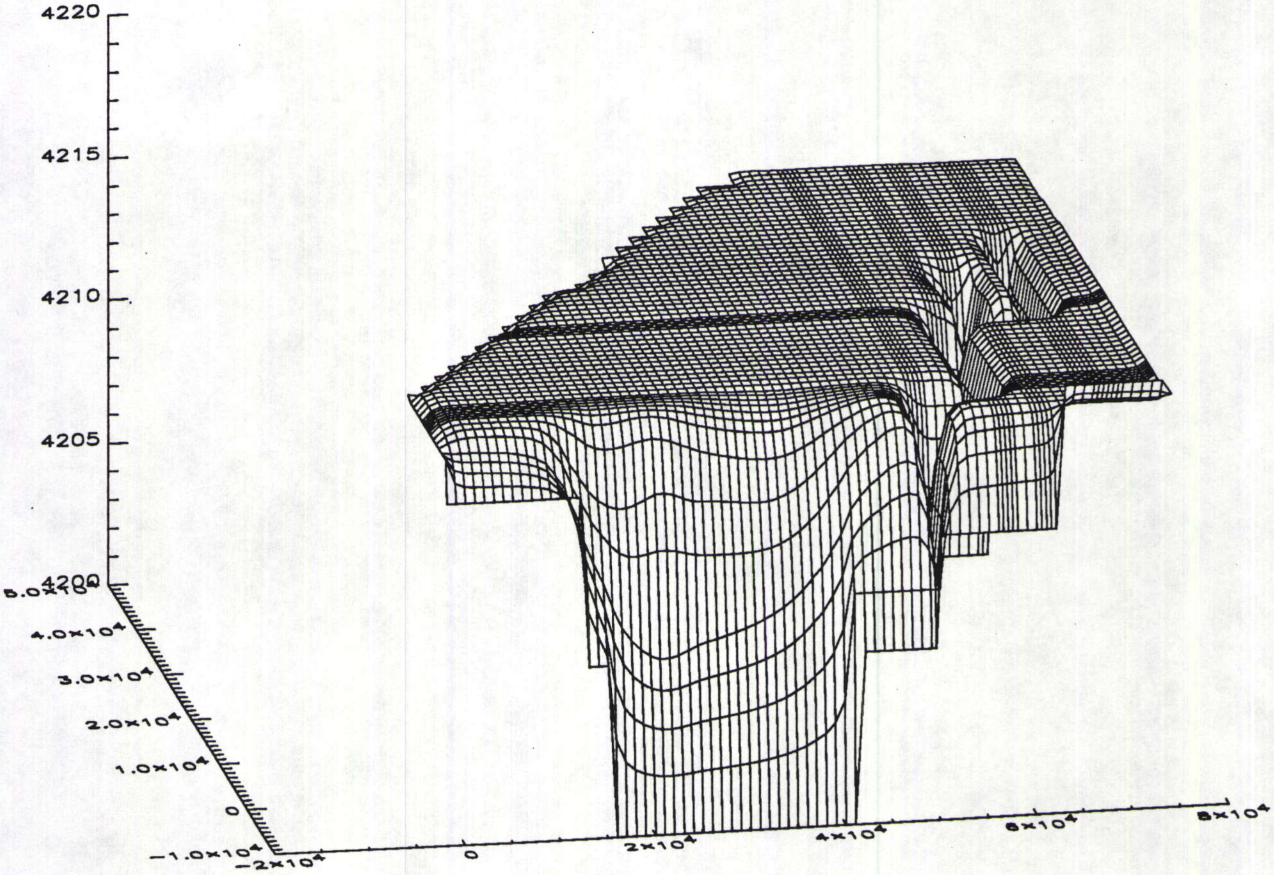


Figure 1.-- Revised model grid.



4220
4215
4210
4205
4200
5.0×10⁴
4.0×10⁴
3.0×10⁴
2.0×10⁴
1.0×10⁴
0
−1.0×10⁴
−2×10⁴
0
2×10⁴
4×10⁴
6×10⁴
8×10⁴

Figure 2.

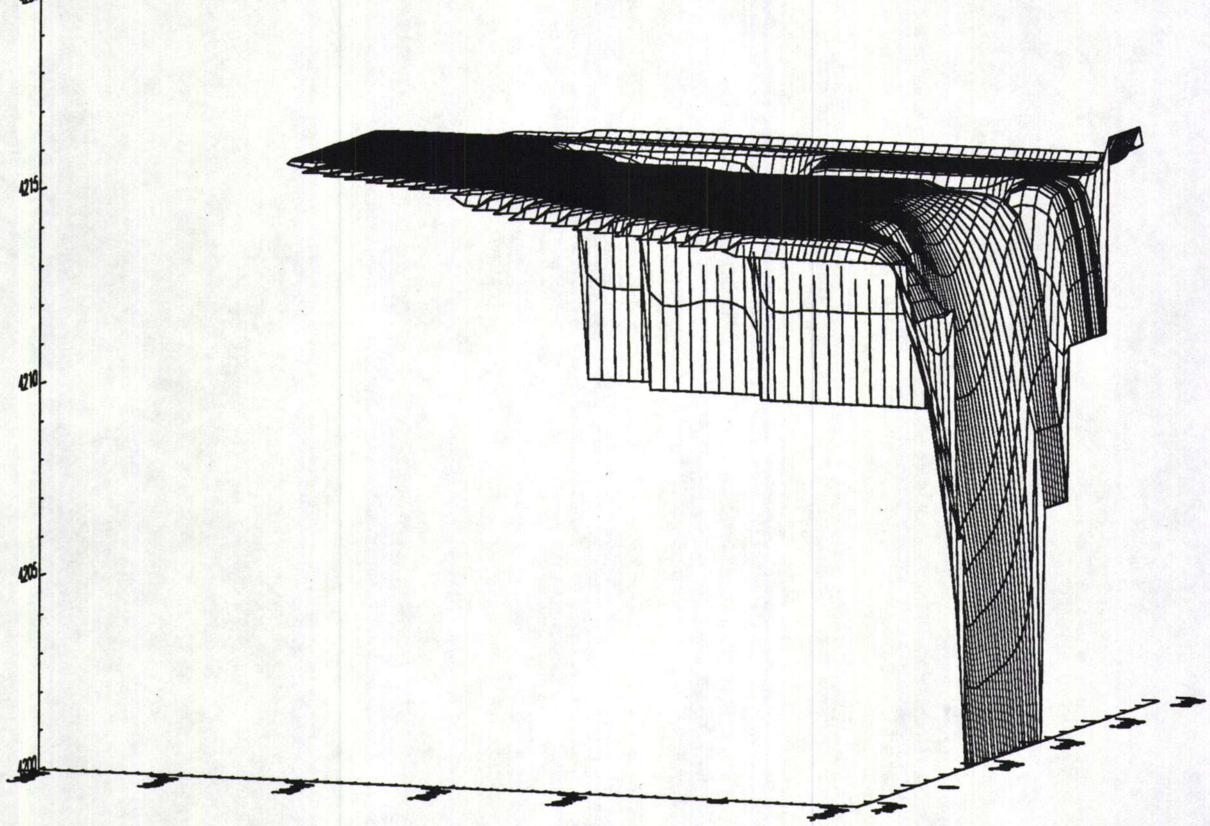


Figure 3.

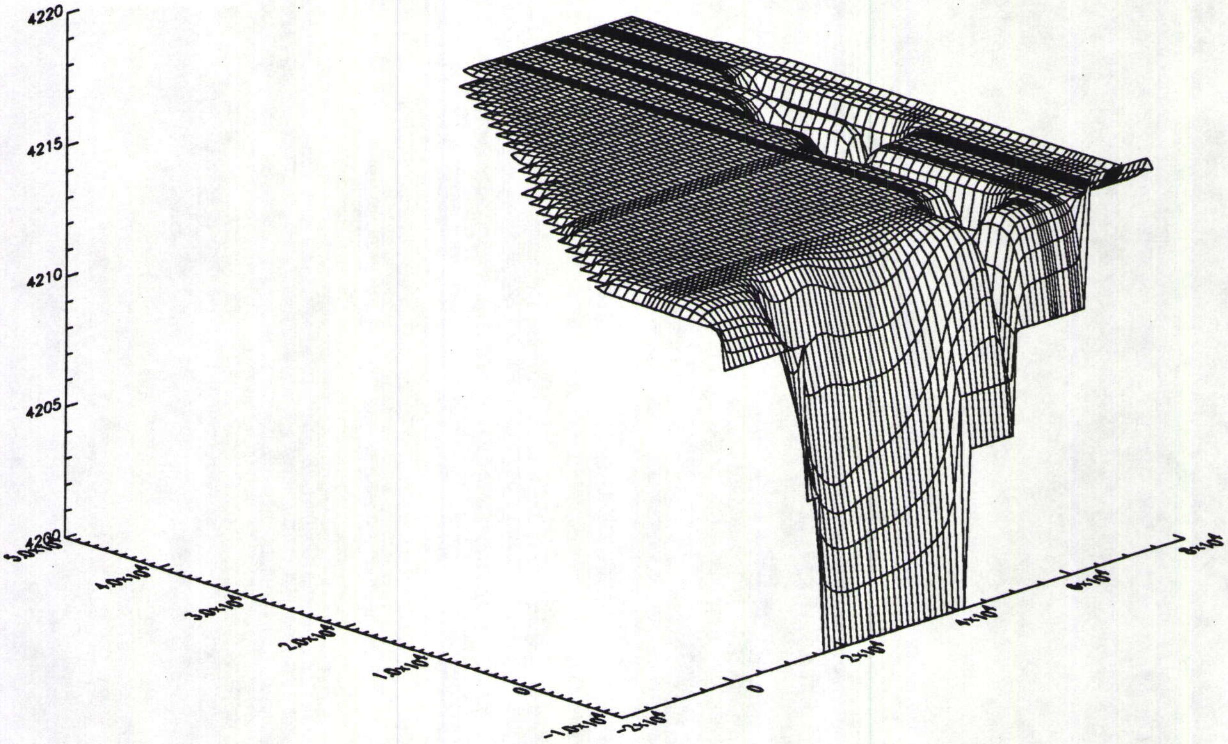


Figure 4.

Boundary flowrates	
Location	amount (#/day)
West	6.6e7
South	-2.2e7
East	2.5e5
North	-2.2e4
Northwest	-1.3e4*
Land surface	0
Bottom	-5.8e5
Ditch	-1.2e7
Inflow	2.4e7
Outflow	5.9e7

* excluding bottom layer